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Abstract

NEUTRON COUNTING IN ACTIVATION ANALYSIS

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This paper reviews recent and current work done at this laboratory on the development and use of neutron counting in activation analysis. The use of neutrons for analysis, although not common practice, is very advantageous, since neutrons can be detected selectively and efficiently without interference from β and γ ray background. In addition, neutron emission is a relatively rare phenomenon in nuclear decay, and when taken together with other properties can be used for identification and assay of specific nuclides and elements. The same is true for the emission of neutrons from nuclear reactions with radioactive sources, where the emission is frequently characteristic of the source and target nuclides.

The specific features of emission and counting of neutrons permit a sample to be analysed without chemical processing prior to or after the irradiation, and facilitate rapid and non-destructive instrumental procedures at high precision, using relatively simple apparatus.

These neutron counting methods consist of the analysis of fissionable nuclides (e.g. U^{235}, U^{238}, U^{233}, Th^{232}, Pu^{239} and isotopic ratios of uranium) by counting the delayed neutron emission from short-lived fission products; analysis of Li^{6} and lithium, N^{15}, O^{17}, O^{18} and oxygen by counting delayed neutrons from 4 sec N^{17}; assay of several high energy gamma ray emitting nuclides (e.g. Na^{24}, Mn^{56}, La^{140} and Al^{28}) in highly radioactive samples where electronic discrimination is ineffective, by counting photoneutrons produced in D_2O and beryllium; and analysis of O^{18} in various phases by counting neutrons from the reaction $O^{18}(\alpha,n)Ne^{21}$.

The different methods and their applications are reported in detail. Further possibilities for extension and development of new methods along the same principles are discussed.